

## 12. Operative Procedures for Peripheral Lymphedema

### One-Stage Curative Surgery for Male Genital Elephantiasis

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### One-Stage Curative Surgery for Male Genital Elephantiasis

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**Objective:** Management of male genital elephantiasis (MGE) is challenging due to its complicated shape and of high risk of lymphorrhea and cellulitis. Complete resection of fibrous tissue and lymphatic reconstruction seems ideal for the treatment of MGE. The aim of this study was to evaluate feasibility of radical reduction and reconstruction (RRR) procedure for MGE.

**Methods:** Patients who underwent RRR procedure were evaluated. RRR procedure consisted of elephantiasis tissue resection followed by soft tissue and lymphatic reconstruction using lymphatic skin flap(s). No compression was applied postoperatively. Patient and flap characteristics, intraoperative findings, and postoperative results were evaluated.

**Results:** Resected tissue volume ranged from 609 to 2304 gram (average, 1457.7 gram). Lymphatic skin flap used for genital reconstruction included superficial circumflex iliac artery perforator (SCIP) flap, tensor fascia lata perforator flap, and anterolateral thigh (ALT) flap. There was no genital lymphedema recurrence in mean follow-up of 21.7 months. Genital lymphedema score significantly improved postoperatively ( $6.9 \pm 1.7$  vs.  $0.5 \pm 0.5$ ,  $P < 0.001$ ).

**Conclusions:** RRR operation allowed one-stage curative treatment for MGE. Lymphatic flap transfer plays an important role in soft tissue reconstruction and prevention of lymphedema recurrence. RRR has a potential to be a choice of treatment for MGE.

## 12. Operative Procedures for Peripheral Lymphedema

### Primary Prevention of Lymphedema using a Lymph Vessel Flap in Extremity Soft Tissue Reconstruction

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**Objective:** Lymphedema can be a significant long-term sequela after reconstruction of extremity soft tissue defect including major lymph pathways. It is ideal to simultaneously reconstruct both soft tissue and lymphatic system for prevention of lymphedema. This study aimed to evaluate efficacy of primary prevention of lymphedema with lymph vessel flap transfer, lymph-interpositional-flap transfer (LIFT), for extremity soft tissue reconstruction.

**Methods:** Patients who underwent free flap reconstruction of extremity soft tissue defects including major lymph pathway defects were divided into 2 groups; LIFT group in which lymph vessel flap was transferred with consideration of lymph axially under indocyanine green (ICG) lymphography navigation, and control group in which a flap was transferred without lymph axially consideration or ICG lymphography navigation. Lymph flow restoration (LFR) and lymphedema development (LED) rates were compared between the groups.

**Results:** One-hundred twenty three patients were included. All flaps survived without partial necrosis. There was no statistical difference in background data between the groups. LFR rate was significantly higher in LIFT group than that in control group (57% vs. 14%,  $P < 0.001$ ). LED rate was significantly lower in LIFT group than that in control group (20% vs. 49%,  $P < 0.001$ ).

**Conclusions:** Simple extremity soft tissue reconstruction has higher risk of LED, and simultaneous lymphatic reconstruction should be performed. LIFT, using lymph vessel flap for bridging a lymphatic gap, allows simultaneous soft tissue and lymphatic reconstruction, and should be considered for reconstruction of extremity soft tissue defect complicated with major lymphatic pathway defect.

## 12. Operative Procedures for Peripheral Lymphedema

### Advantages of the use of BPV + ICG vs only BPV in lymphatic-venous bypass surgery

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### Advantages of the use of BPV + ICG vs only BPV in lymphatic-venous bypass surgery

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**Objective:** The objective of this study was to improve the long term outcome of lymphatic-venous anastomosis (LVA) in patients with lymphedema using both the blue dye (BPV) and ICG fluorescence during surgery.

**Methods:** From April 2022 to March 2023, 56 patients suffering from primary or secondary lower limb (LLL) or upper limb lymphedema (ULL) underwent LVA surgery using BPV and ICG.

Postoperative evaluation included volume measurements, lymphoscintigraphy, functional disability.

**Results:** LVA was performed in 56 patients, 23 with primary lymphedema (1 ULL, 22 LLL) and 33 with secondary lymphedema (14 ULL, 19 LLL). Secondary lower limb lymphedemas followed uterine cancer (9), prostate cancer (4), ovarian cancer (2), trunk skin tumors (2) and venous surgery (2). Secondary upper limb lymphedemas were all related to breast cancer treatment (14). All lower and upper primary lymphedemas were due to truncular lymphatic malformation and specifically to lymph nodal malformation (LAD II, according to Papendieck's classification).

**Conclusions:** The advantages to use both BPV plus ICG compared with only BPV are represented by a better planning of the surgical approach, better finding of lymphatics and lymphnodes, better visualization of also deep lymphatics in the surgical wound, better assessment of LVA patency, improvement of short and long term results.

Keywords: Lymphatic- venous; Lymphedema; Microsurgery; ICG; Fluorescence.

## 12. Operative Procedures for Peripheral Lymphedema

### Patient-Reported and Non-Contrast Magnetic Resonance Lymphography Outcomes Following Vascularized Lymph Node Transfer Surgery for Lower Limb Lymphoedema

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**Introduction:** Lower limb lymphoedema remains a concern as there is no consensus on the best approach or surgical treatment. Vascularized lymph node transfer (VLNT) has gained popularity, and clinical results are encouraging, but evaluating outcomes can be difficult. In this study, we assessed the outcomes of patients who underwent VLNT surgery based on clinical examination, photographic documentation, non-contrast magnetic resonance lymphography, a quality of life (QoL) assessment tool for lymphoedema of the limbs (LYMQOL) and reported the effect of surgical treatment on limb circumference and skin quality.

**Methods:** This is a retrospective study of patients diagnosed with lymphoedema who underwent at least one VLNT. Patients had a pre-operative and a post-operative clinical examination in combination with photographic documentation 1 and 6 months after the surgery. Patients were asked to complete a LYMQOL questionnaire at their last follow-up and to report the effect of the observed surgical treatment on the circumference of the affected limb and skin quality based on their own perception and self-measurements.

99 patients were identified, and 48 were available for analysis. Of these, 13% were men, and 87% were women, with a mean age of 44. Half of the patients were diagnosed with primary lymphoedema, and the other with secondary lymphoedema. The mean follow-up time was 48 months. 67% patients received a VLNT in the inguinal region and 33% in the knee region for distal lymphoedema. 38% patients with extended lymphoedema required an additional VLNT, 98% a liposculpture, 46% lymphaticovenous anastomosis and 6% dermolipectomy. 27 patients have presented with pre-operative and post-operative NCMRL images.

**Results:** 77% patients reported a decrease in the *circumference* of the affected limb, 17% observed no change and 6% observed an increase in the circumference. 65% patients reported improvement in *skin quality* after the surgical treatment, 27% observed no change, and 8% observed a decrease of the skin quality. Regarding the *LYMQOL questionnaire* results, the mean score of the 'Overall quality of life' was 6,9 (range 1–10, SD: 2). Regarding the results of the NCMRL, the improvement of the drainage of the limb is objective: lymphatic neogenesis was observed in 93% patients.

**Discussion:** Patients with lower limb lymphoedema who received a combined treatment of VLNT and adjuvant surgical procedures exhibited clinical improvement and improvement based on the NCMRL evaluation. Although the outcomes of the LYMQOL questionnaire are variable across the literature, our research, boasting one of the largest cohorts hitherto among similar studies, makes a significant addition to the existing knowledge. In addition, this study is one of the rare ones to use this combination of the VLNT outcomes evaluation tools and has suggested that NCMRL is a preciser evaluation tool in comparison to the clinical one, as it can demonstrate lymphatic neogenesis in the affected tissue. These findings can help to optimize personalized lymphoedema surgical treatment plan.





## 12. Operative Procedures for Peripheral Lymphedema

### Patient-Reported Quality of Life and results Following Vascularized Lymph Node Transfer Surgery for Upper Limb Lymphoedema

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#### ***Title: Patient-Reported Quality of Life and results Following Vascularized Lymph Node Transfer Surgery for Upper Limb Lymphoedema***

**Introduction:** Upper limb lymphedema remains a concern due to the lack of consensus on the best approach or surgical treatment. Vascularized lymph node transfer (VLNT) has gained popularity, and clinical results are encouraging; however, the evaluation of outcomes is limited to few studies. In this study, we assessed the outcomes of patients who underwent a VLNT based on a quality of life (QoL) assessment tool for lymphedema of the limbs (LYMQOL). Secondly, we reported the effect of the treatment on limb circumference, skin quality, and the patient's ability to work.

**Methods:** This retrospective, observational study analyzed all patients diagnosed with upper limb lymphedema who underwent at least one VLNT. Patients were asked to complete a LYMQOL questionnaire at their last follow-up and report the effect of the surgical treatment on the circumference of the affected limb, skin quality, and their ability to work based on their own perception and self-measurements.

**Results:** Seventy patients were identified, and 51% were available for analysis with a mean age of 57 and a mean follow-up of 40 months, 97% were females.

The lymphedema was primary in one case (3%) and secondary in 35 patients (97%). In this subgroup, the lymphedema was cancer-related in 34 cases (97%) and trauma-related in one (3%). Thirteen patients (36%) did not undergo any surgical treatment before the VLNT, 17 (47%) used bandaging or compression garments, 19 (53%) used manual lymphatic drainage or pressotherapy, and four patients (11%) used other forms of treatment.

Thirty-three patients (92%) received a VLNT to the thoracodorsal vessels in the axillary region, and three (8%) received a VLNT to a perforator vessel at the volar aspect of the elbow. Ten elephantiasis patients (28%) required an additional VLNT. Twenty.

78% that had a VLNT underwent a liposculpture, 11% a dermolipectomy, and one (3%) a lymphaticovenous anastomosis. There was no donor-site induced lymphedema.

75% patients reported a decrease in the circumference of the limb, eight (22%) observed no change, and one observed an increase in the circumference. Sixteen patients (44%) reported an improvement in skin quality, sixteen (44) reported no change, and four (11%) observed a decrease.

Regarding the LYMQOL questionnaire results, the mean score for the 'Function' section was 19.1 the mean score for the 'Appearance' section was 11.2), the mean score for the 'Symptoms' section was 10.9 and the mean score for the 'Mood' section was 9.5 The mean score of the QoL was 7

### **Discussion:**

Upper limb lymphedema is more common in females affected by cancer. Vascularized lymph node transfer (VLNT) often requires additional interventions. Although most patients perceived a decrease in the circumference of their limb after VLNT, the impact on skin quality and ability to work is less clear. The effects of VLNT on quality of life have not been extensively studied, so our investigation provides a valuable contribution, particularly in terms of self-reported measurements. Despite variable outcomes of the LYMQOL questionnaire in the literature, our study, which boasts one of the largest cohorts among similar studies, significantly adds to existing knowledge. Further prospective and randomized studies are necessary to assess treatment effectiveness for patients with this condition.

The lymphoMRI allows to objective the clinical results and allows to predict the results: improvement of the drainage of the limb, less fat and liquid, new lymphatic vessels and flap visible. This is the next step of our study

## 12. Operative Procedures for Peripheral Lymphedema

**Increasing the Lymphatic Flow following end-to-end Lymphovenous Bypass anastomosing the lymphatic to the vein side branch with ligation of the distal main vein**

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**Increasing the Lymphatic Flow following end-to-end Lymphovenous Bypass anastomosing the lymphatic to the vein side branch with ligation of the distal main vein**

Nowadays, lymphovenous bypass (LVB) has become one of the most accepted microsurgical options for treating extremity lymphedema.

LVB can be performed in different configurations, such as end-to-end, end-to-side, and side-to-end. Each bypass configuration has its own advantages and disadvantages, and its efficacy is still not clear. Among them, side-to-end bypass is considered to be the most effective as the lymph flow is drained from both sides, antegrade and retrograde, with a single bypass.

In this discussion, we would like to describe our observation of one LVB performed with end-to-end configuration with the lymphatic duct anastomosed to the side branch of the recipient vein. LVB was performed using a 40x surgical microscope. A large size discrepancy between the lymphatic duct (0.6mm) and the recipient vein (2mm) was noted. However, the presence of a side branch(0.6mm) allows us to perform the anastomosis in end-to-end fashion. Immediately after the anastomoses, venous-lymphatic reflux (VLR) was noted and was converted to venous washout (VW) successfully with ligation of the distal vein. The distal vein of LVB was clamped temporarily for at least 15 min to ensure the presence of VW prior to permanent ligation. Clamping the distal main vein on end-to-end bypass with the lymphatic anastomosed to the vein side branch, we can clearly observe no venous back bleeding running into our LVA; instead, an increased lymphatic flow running into the vein was shown both clinically with the blue patent and with the ICG lymphography.

A possible physical explanation for the improved lymphatic outflow by clipping the distal vein can lie in the fundamental law of fluid dynamics  $\text{Flow} = \Delta P / R$ . This law describes that the entity of the flow between two points is directly proportional to the pressure gradient and inversely proportional to the resistances: this means that other conditions being equal, the greater the pressure gradient, the greater the flow will

be. By clipping the vein, it is emptied, and therefore the pressure inside is reduced, increasing the gradient between the lymphatic vessel and the vein itself.

The limitation of this observation is that we do not have a quantitative measurement of the flow. Since it is not possible to quantify the intraluminal pressure of small vessels less than 1mm in caliber, the delta pressure between the lymphatic duct and the recipient vein can only be assessed by direct intraoperative observation by evaluating under microscope the direction of lymph flow under the normal light and by using ICG lymphography.

Since venous back bleeding is prone to anastomotic thrombosis, we believe that performing distal ligation of the main vein to achieve a VW with increased lymph flow into the vein could be beneficial, which may allow better functional recovery of lymphedema. More studies are needed to prove this clinical observation, that at the moment seems to be a logical decision.

### 13. Technological Requirements for Lymphatic Surgery

#### Characteristics of Breast Cancer-Related Lymphedema through Follow up Lymphoscintigraphy

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#### Characteristics of Breast Cancer-Related Lymphedema through Follow up Lymphoscintigraphy

##### **Abstract**

Objectives: To investigate long-term changes and associations in clinical features and lymphoscintigraphy in breast cancer related lymphedema (BCRL) patients.

Methods: This is a single-center cohort study of BCRL patients who underwent baseline and follow-up lymphoscintigraphy . The percentage of excessive circumference (PEC) of the affected upper limb compared to the unaffected side was used as a clinical severity of BCRL. Each 99mTc-phytate lymphoscintigraphy image was categorized into 0–6 stages according to Taiwan lymphoscintigraphy staging system. Clinical parameters including PEC and the lymphoscintigraphy stage at baseline and follow-up were compared and analyzed.

Results: A total of 87 patients were included. Baseline and follow-up lymphoscintigraphies were performed at median 7 (interquartile range [IQR] 2–4) and 78 (IQR 49–116) months after surgery, respectively. Both lymphoscintigraphy stage and PEC changed variably during the study period with overall increase in their severities (median PEC: 3.8% to 13.4%; median lymphoscintigraphy stage: 1 to 4). The PEC and lymphoscintigraphy stage showed positive correlation at baseline ( $\rho = 0.27$ ,  $P = 0.001$ ) and follow-up ( $\rho = 0.50$ ,  $P < 0.001$ ). The stepwise multivariable analysis revealed cellulitis

(adjusted  $\beta$ : 4.34; 95% confidence interval [CI] 0.77–7.91) and lymphoscintigraphy stage at follow-up (adjusted  $\beta$ : 1.47; 95% CI 0.67–2.28) as independent variables for PEC at follow-up.

Conclusions: The clinical course of BCRL and lymphoscintigraphy pattern showed diverse changes during long-term follow-up. In addition to initial lymphoscintigraphy for the diagnosis, follow-up lymphoscintigraphy can be useful to visualize functional changes in lymphatic system that may help to guide the optimal management plan in BCRL.

## 14. Liposuction & Lymphatic Microsurgery

### Complete Reduction of Leg Lymphedema Following Liposuction – A Five-Year Prospective Study in 67 Patients without Recurrence

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#### **Background**

Lymphedema leads to adipose tissue deposition, which is not possible to remove by conservative methods. Previous studies have shown a complete reduction in the excess volume in the lymphedematous limb when treated with liposuction and controlled compression therapy (CCT). We present the long-term outcomes of all patients treated with liposuction and CCT for lower extremity lymphedema (LEL) who were followed for five years.

#### **Patients and Methods**

Sixty-seven patients with LEL were treated with liposuction and CCT. Thirty-six patients had primary lymphedema and 31 patients had secondary lymphedema. Outcomes included excess leg volume over a follow-up period of five years. Any association between patients' characteristics and treatment outcome was analyzed including aspirate volumes.

#### **Results**

The preoperative excess volume prior was 3515 ml (interquartile range (IQR): 2225 – 5455) and the volume ratio to the non-affected leg was 1.35 (IQR: 1.25 – 1.53). One year after treatment, the excess volume had decreased by 101% (IQR: 84 – 116). The decrease in excess volume continued during the five-year follow-up and at the end of the study, the excess volume had decreased by 115% (IQR: 98 – 124). No major complications occurred.

#### **Conclusion**



Liposuction and CCT is a safe and effective procedure to remove excess adipose tissue and to achieve normalization of the leg volume in late-stage LEL. When no satisfactory result is obtained with conservative methods such as compression garments, and there is no or minimal pitting on examination of the limb, excess adipose tissue is present and liposuction could be considered.

## 19. Lymphatic Filariasis and Tropical Lymphedema

### Unified Care Plan for Severe Lymphedema in a Tropical Country

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### Unified Care Plan for Severe Lymphedema in a Tropical Country

#### ABSTRACT

**Introduction:** Over the past 30 years and an experience of over 4000 cases at our own as well as associated clinics, our protocol for management of Lymphedema has evolved to a consistent and effective care plan, irrespective of cause. The average limb volume reduction is 59% as compared to normal side results higher in cases with severe disease. The principles approach is:

- A. Use of a team headed by a lymphedema surgeon with a lymphedema counsellor interacting with patient and family. Patients are encouraged to interact with each other directly as well as through social media. They provide support and advice to each other.
- B. Hybrid care consisting of CDT. The focus is on skin hygiene, moisturizers, care of the common fungal infection between the webs, compression therapy through pumps and bandages suitably altered for tropical environments along with exercises. Manual Lymph Drainage (MLD) is reserved for selected cases only.
- C. Prophylactic Benzathine Penicillin.
- D. Judicious debulking which may be liposuction alone, but more commonly requires skin removal also. This is related to secondary changes like verrucae, scarring or excessive folds. The goal of debulking is to ensure long-term self-care through appropriate compression
- E. Lifelong self-care by patients and family. For this appropriate counselling as well as training on self CDT is important

- F. Maintenance through telemedicine through photographs, video based counselling as well as a software which allows self-assessment of limb volume.

A few case reports of about 50 such treated are provided. More can be presented if time permits.

**Case 1.** 72-year-old lady from Assam. She had been operated for Left Ca Breast 25 years back. There were large lumpy masses in the upper arm and distal forearm. These would impinge on the chest and hence the hand could not be used for feeding, or any other activity. There was fungus between the finger webs. The right arm and leg were also non-functional due to malunited and displaced fractures. After good skin hygiene and starting penicillin, CDT helped to reduce the swelling from 14.2 litres to 10.2 litres in 10 days. The masses were now smaller. These were surgically removed and liposuction done. Patient was sent home 5 days later with the advice of self-bandaging and a Velcro Wrap. A month later the limb volume was 4.7 litres and she can use the arm for day to day work.

**Case 2.** 21-year-old male from a filaria endemic area. Massive swelling of the foot and lower leg with additional warty lesions on the toes. He wanted to be able to wear shoes. A nodo-venous shunt along with CDT resulted in reduction of volume from 18.9 to 11.3 litres. Debulking was done a week later of the foot and ankle. A year later the volume decreased further to 6.8 Litres when another debulking session was done mostly for residual warty lesions in the toes. He continued self-management at home through IPC, stockings and self- bandaging. He remains well with a limb volume of 6 litres 10 years after surgery.

**Case 3.** 35-year-old bus driver had post traumatic lymphedema with smelly ulcers making him suicidal, as he did not find relief for over 5 years. After adequate counselling and only conservative management his limb is now near normal. He has become an active proponent of self-bandaging who counsels other patients whenever he comes for follow up. He has also posted videos on how to bandage in social media.

**Conclusion:** A standardized care protocol has outcomes even in severe Lymphedema which is common in tropical regions.

## 19. Lymphatic Filariasis and Tropical Lymphedema

### Complete Decongestive Therapy (CDT) for lower limb filarial lymphedema in a community setting

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### Complete Decongestive Therapy (CDT) for lower limb filarial lymphedema in a community setting

#### ***Abstract***

**Background:** Filariasis is among the six recognized Neglected Tropic Diseases, the elimination of which has gained much attention and funds. The Global Program for Elimination of Lymphatic Filariasis rests on the twin pillars of MDA (Mass Drug Administration) and Morbidity Management and Disease Prevention (MMDP). In India, only leg washing is offered as part of MMDP for lymphedema. The Indian government considers Complex Decongestive Therapy (CDT) to be too expensive for mass scale deployment.

The authors are from an urban Centre of Excellence (CoE) in Lymphedema care. The care protocol followed is a modified form of Complete Decongestive Therapy (CDT), with emphasis on local hygiene, penicillin, compression and exercises. Non use of Manual Lymphatic Drainage and adequate training for home based self-care has led to appreciable outcomes despite there being a short initiation phase.

A request for care assistance for filariasis patients was received in 2015 from an agricultural worker collective in Sitapur district, Uttar Pradesh, India, a filaria endemic area. They had patients who poor daily wagers, and costly care, let alone travel for the same. With funding support in

the form of low-cost bandage materials through a local philanthropist, filaria camps were organized in a community health centre. A suitably modified and far less expensive care protocol was tested.

Two camps were held in November 2015 and a follow up camp in January 2017. Self-care overseen by trained local health and remote monitoring by the lymphologist and therapist continued till end 2017. A special software for lymphedema care which provided limb volume assessment was part of the care protocol. This retrospective study compares outcomes with emphasis on limb volume between patients treated in the endemic area versus those treated only conservatively at the urban clinic.

**Methods:** We first trained the doctors, staff, and local health workers (Accredited Social Health Activists or ASHA) at the community health centre on record keeping, as well as assist patients in bandaging, exercises and other components of self-care. Patients were examined and their limbs measured. After leg cleaning and prophylactic penicillin, the bandaging process was explained and demonstrated. Volunteers assisted the process and after learning the finer points of CDT, continued to hold monthly camps. Patients were encouraged to continue cleaning and rebandaging at home. Special efforts were made to educate them about the requirements of long-term care. Remote consultation and monitoring through telehealth was occasionally required.

**Results:** Data from 50 patients with lower limb lymphedema from Sitapur is available. The fall in limb volume at 1-2 days, 2 to 30 days, and 60 to 180 days, and 1 to 2 years was 559 ml, 227 ml, and 105 ml respectively. At one to two years of follow up the average fall in limb volume (lower limbs only) was 927 ml. This compared well to our data from our clinic in Delhi, where the average fall in limb volume for a similar cohort - i.e. when surgery was not performed, was 775 ml ( $p=0.33$ ).

**Conclusions:** CDT for lymphedema is easily feasible at the community level Results comparable to those obtained when patients are treated at an urban centre are possible with use of affordable and locally available materials assisted by remote monitoring.

